Chapter 13

PHOTOGRAPHY FROM THE AIR

232. General

As stated previously, generally intelligence requirements for photographic coverage from the air of some subject, installation, or area are imposed on commands or flying units responsible for photo-reconnaissance and aerial penetration. These echelons are trained and equipped with specialized aircraft and camera equipment, some weighing tons and specially designed for aerial photography. Information on techniques and procedures of these organizations are contained in publications on this subject and are available upon request. However, because of certain international laws and agreements there are many areas in which reconnaissance forces cannot operate. In these areas, the responsibility for collection of aerial photography lies with other collectors.

233. The Collector's Role in Aerial Photography

All field collectors, whether they be intelligence officers, pilots, crew members or other related personnel, or operating units, may have splendid opportunities for collecting valuable intelligence information from flying aircraft. This type of photography may be accomplished when they are passengers in United States or foreign military aircraft or scheduled airliners passing near or through foreign countries, or in their capacity as pilots or personnel of their own country's aircraft whose itinerary or operational mission brings them near or over areas and installations of air intelligence interest. In this discussion on aerial photography, we are primarily concerned with the hand-held type of camera, whether it be a Leica type, a specially designed, hand-held aerial camera such as the K–20, shown in figure 25, or a motion picture camera. However, since occasionally a vertically mounted camera is available, general guidance on use is given here and each collector with a possibility of using one of these should be sure to receive complete familiarization on the operation of that particular camera unit.

234. General Techniques

Some of the techniques previously presented to permit more successful photography from moving vehicles (figures 141 through 144) also will apply to oblique photography from aircraft—vibration and sudden movements being the two greatest problems. Photography obtained from any moving vehicle, including aircraft, should be made with the highest shutter speed and largest lens opening permissible under existing light conditions. Unlike in moving trains and cars, the collector will be unable generally to shoot from an open window. When shooting through glass this fact should be reported, for in such shots distortion nearly always is present to some degree and hence must be taken into consideration during analysis. As a guide for the collector in this type of photographic activity, some general techniques, approaches, examples of good and bad shots, proper and improper angles and approaches, and other representative types of aerial photographs, with information that can be derived from them, are illustrated in figures 151 through 159. Where possible, it is desirable to obtain long-range, medium-range, and me-

dium-close views by means of aerial photography (see figures 152 and 153) and to back this up with ground photography. Where the aircraft is equipped with a camera mount or other means to accomplish vertical photography, vertical overlapping prints take first priority for stereo study and accurate measurements, with oblique and ground photography as desirable supplements. The verticals should have 60 percent overlap along the line of flight for ideal use by analysts. (See table XVII for determination of interval.) If more than one flight line is required to cover a target area, the vertical photography should have a 60 percent overlap in line of flight and a 20 to 30 percent sidelap on adjoining flight lines. (See figure 154.) Naturally, steadiness of the aircraft in flight will improve the photography materially. An important consideration in taking aerial obliques is to have the camera at such an angle as to fill the exposure image with terrain rather than a great deal of empty sky or water. (See figure 155.)

235. Aircraft Altitude

The altitude of the aircraft is important in aerial photography and should be carefully considered for several reasons when there is any possibility for choice of altitude. One reason is picture coverage in obliques; another is intervalometer settings or interval between shots in verticals. Scale of the photography is extremely important to analysts and of course is dependent on altitude in accordance with the following formula:

$$\frac{\text{Focal length of camera}}{\text{altitude}}=\text{scale or } \frac{12 \text{ inches}}{12{,}000 \text{ feet}}=\frac{1}{12{,}000}=\text{scale}$$

Generally speaking, within limits allowable by coverage desired, the larger the scale the more useful to photo interpreters and analysts. Tables XVII, XVIII and XIX may prove helpful in determining intervals, scales and area coverage.

TABLE XVII.—*Computing Time Interval Between Exposures*

Interval or cycle is the time interval that lapses between exposures. To compute the interval for any given set of conditions, the distance the plane must travel between exposures is calculated first, then by knowing the ground speed of the aircraft, the time interval is easy to compute.

EXAMPLE: An aircraft flying at a ground speed of 200 miles per hour is to make a reconnaissance run at 5,000 feet using a K-20 camera equipped with a 6⅜ inch lens. What is the interval necessary to yield a 65% forward or progressive overlap?

GIVEN: Ground speed=200 mi/hr
Altitude =5,000 feet
Negative size =4" x 5"
Focal length =6⅜"
% overlap =65%

SOLUTION: Scale=1:9410
9410 ÷ =784 ft/in
Negative is 4 inches long in line of flight
100%−65%=35%
4×0.35=1.40 inches
1.40 in.×784 ft.=1098 ft. between exposures.
Compute how many feet the aircraft will travel in one second if it is traveling at 200 mi/hr
200 mi=200×5,280=1,056,000 ft
1 hour=60×60=3600 sec.
$\frac{1{,}056{,}000}{3600}$=293 ft/sec.
If the aircraft travels at a rate of 293 ft/sec. and it must travel 1098 ft. between exposures, the time interval is
$\frac{1098}{293}$=3.74 sec.

TABLE XVIII.—*Determining Scale With Factor for Focal Length*

A factor is given for each focal length.
The factor X altitude=scale.

LENS	FACTOR
6"	2.0
*6⅜"	1.882
7"	1.714
8"	1.5
8¼"	1.454
12"	1.0

*This focal length available in the K-20 camera.

TABLE XVIII—*Continued*

LENS	FACTOR
20"	0.60
24"	0.50
36"	0.33
40"	0.30
48"	0.25
60"	0.20

TABLE XIX.—*Computing Field of Coverage*

By field is meant the ground area covered by one photograph.

EXAMPLE:

How large an area will be covered by a K-20 camera equipped with a 6⅜ inch lens at 10,000 feet altitude?

SOLUTION:

A K-20 camera takes a picture size 4" x 5"

Scale= $\frac{10,000}{6\frac{3}{8}}$ =1569 ft/in

4×1569=6276 ft.÷5,280=1.2 mi.

5×1569=7845 ft.÷5,280=1.5 mi.

The area covered is 1.2 mi wide and 1.5 mi long. 1.2×1.5=1.8 sq. mi.

236. Location of Subject Matter Photographed

Unless the subject item, installation, or area photographed can be accurately located or pin-pointed and its known or apparent purpose generally described, the photograph may be of little or no value. Therefore, either through the use of maps, good annotations, overlays, or detailed descriptive reports, effort should be made to locate the subject as accurately as possible. Among some of the items that should be included with the photographic information are those listed in paragraph 137 plus direction and altitude of aircraft, focal length of camera, and perhaps light and weather conditions existing at the time. Taking additional long range photography showing the target's relation to known terrain or cultural features might assist the analyst in locating the target.

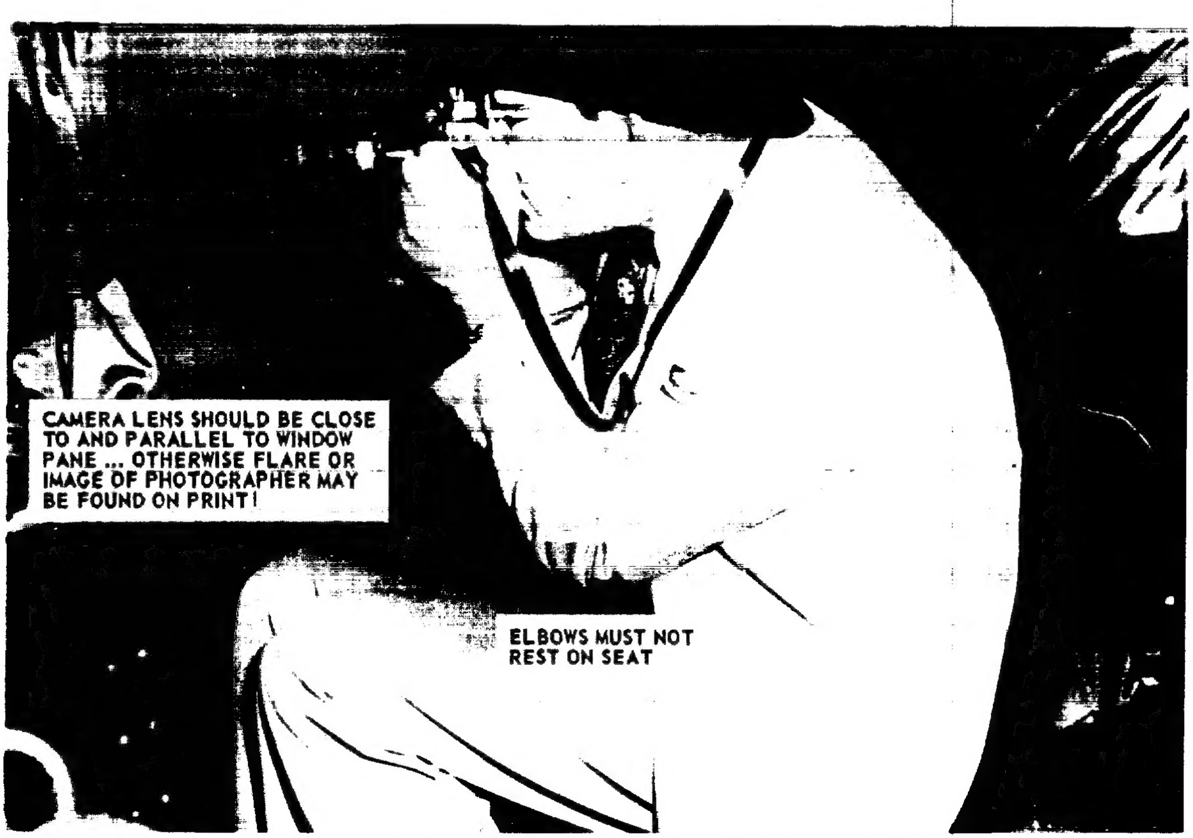
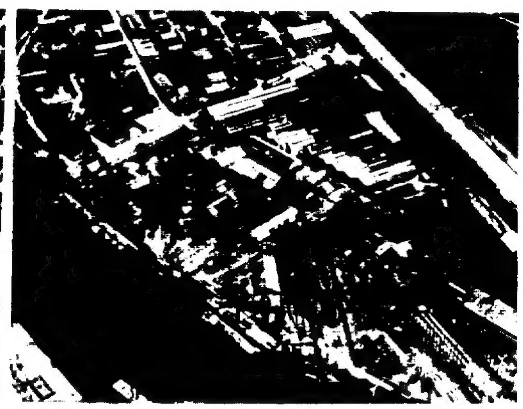


Figure 151. General Technique for Photographing from Aircraft

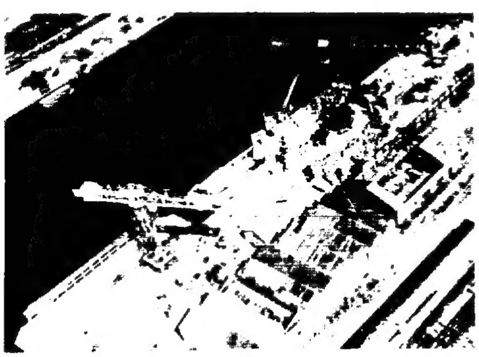
A long-range view shows the relationship of the subject to the surrounding area.

Subject fairly well-framed; landmarks in background.

Medium-range view gives the layout. Good detail, but could have been framed to include entire installation.



Medium-close shot. Excellent detail for study.



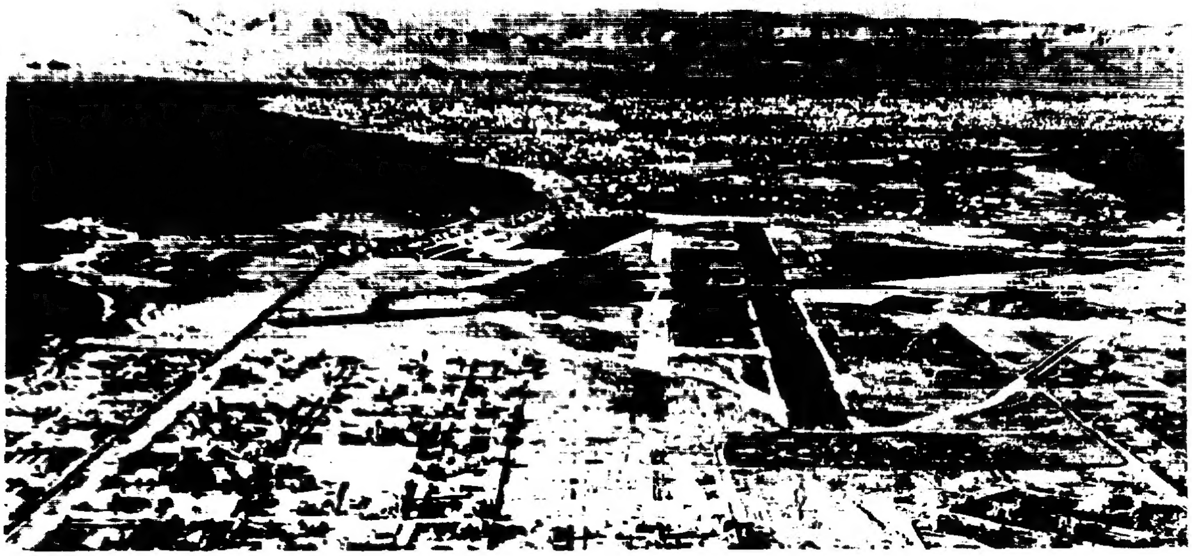
Close-range views should show significant features, large equipment, etc.

Note: When photographing installations show:

1. Where they are located--by long-range views.
2. The plant or installation lay-out (include entire installation) with medium range views.
3. Significant features, key points and details--with medium-close to close-range views.

(All K-20 shots, contact, cropped)

Figure 152. Examples of Aerial Oblique Long, Medium, and Closerange shots



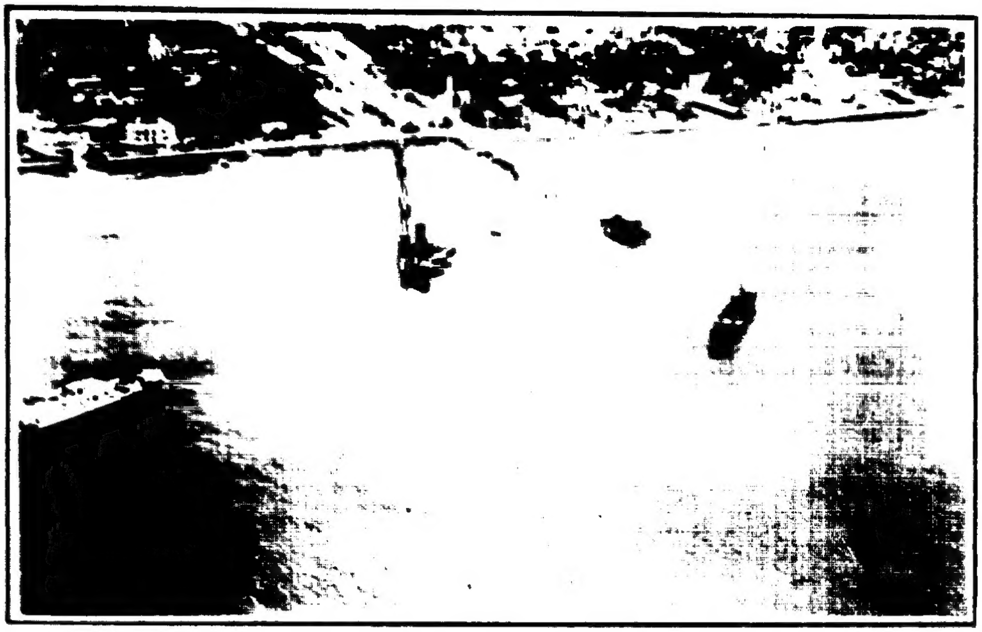
Long- to medium-range aerial oblique of an airfield showing the relationship of the subject to the surrounding area. Altitude approximately 3000 feet.

Medium- to close-range aerial oblique of the same airfield showing the layout and available facilities. Altitude approximately 1500ft.

Figure 153. Examples of Good Photographic Coverage from Aircraft

K-20 vertical, overlapping and sidelapping prints to form a mosaic. (Contact prints which were reduced after assembly.)

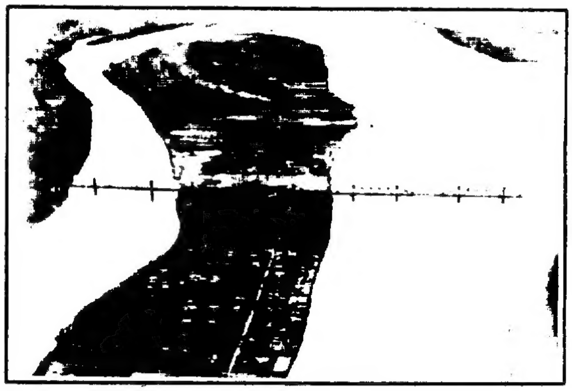
Figure 154. Examples of Overlapping and Sidelapping Prints to Form a Mosaic



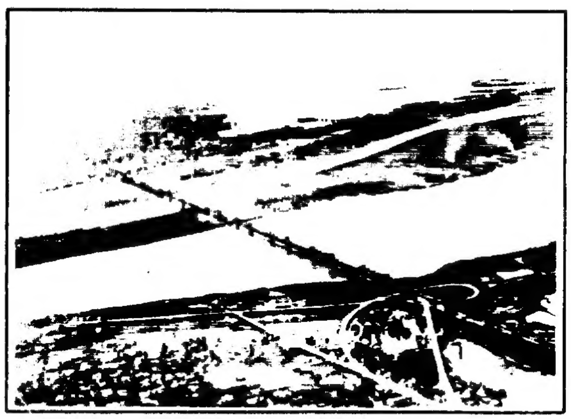
Poor composition. Camera depressed too far resulting in too much water area and too little of the urban area for location purposes. The shot was aimed paralled to pier, hence construction details are not readily discernable.

Same area as above. The camera was depressed sufficiently to show pier in foreground and to include enough background detail for location purposes. Note that this photo was taken at an angle to the pier, thereby showing more detail of construction and lifting equipment.

Figure 155. Good and Bad Aerial Photo-Coverage Techniques

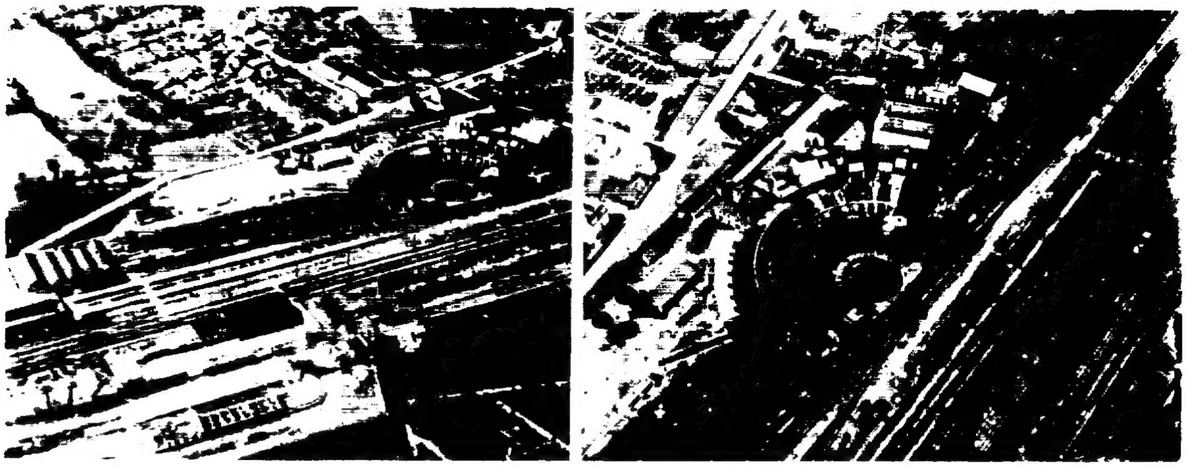


Photographing a large bridge head-on leaves much to be desired. The approaches, length, number of spans, etc. are not shown. See photo below.



Photographing a bridge at an angle, such as the long-range view above, gives the information desired. An additional shot from the opposite direction and taken from the other side of the bridge would give more complete information.

Figure 156. Proper and Improper Angles for Air Photography



Medium-range aerial oblique showing rail facilities.

Close-range aerial shot for revealing significant features.

Figure 157. Proper Coverage of a Strategic Subject to Show Details and Significant Features

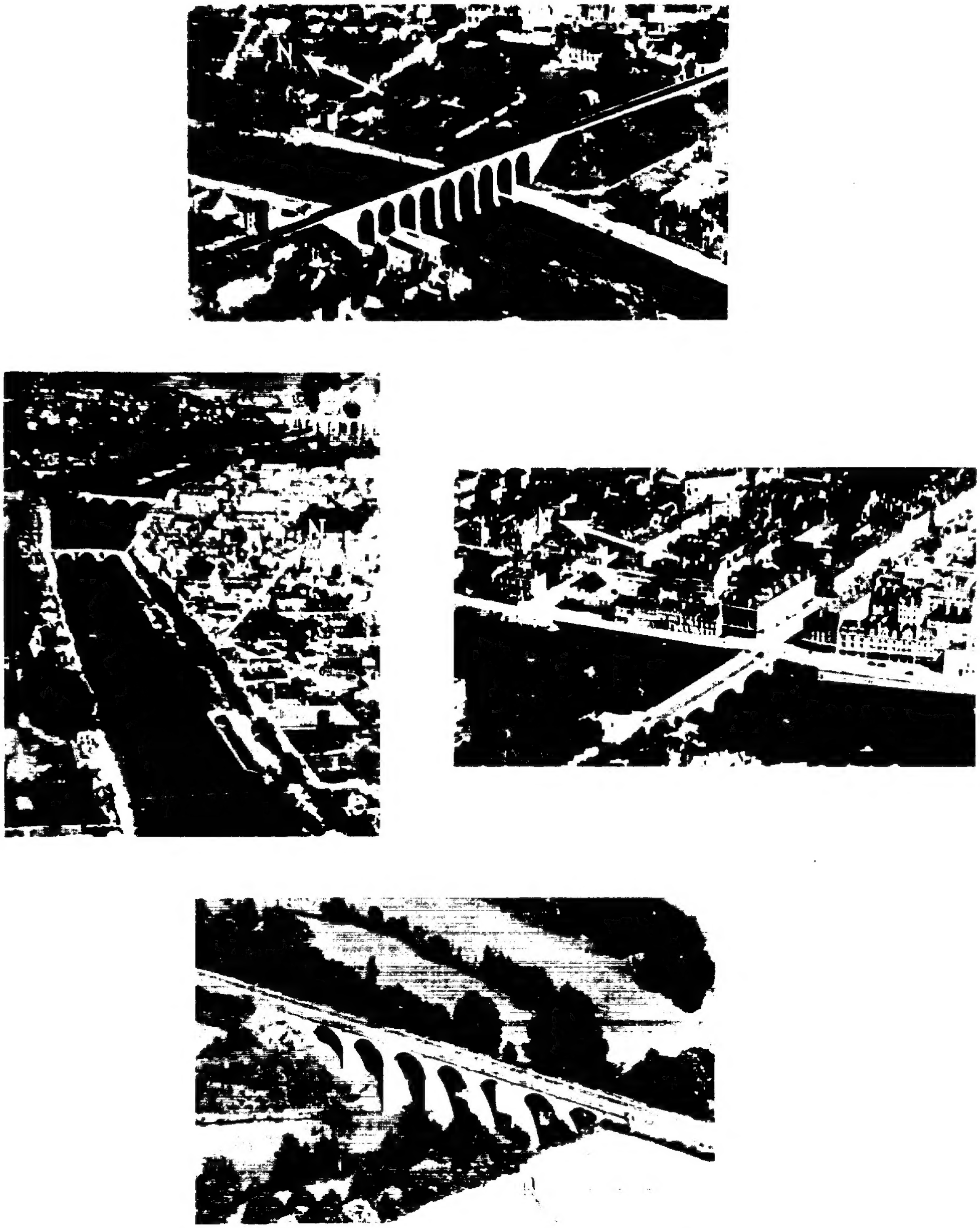


Figure 158. Good Examples of Aerial Photos Taken with Leica Camera Equipped with 135-mm Lens